



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/672,416	09/26/2003	D. Morgan Tench	03RSC004	8435

44859 7590 09/14/2005

JOHN J. DEINKEN  
1049 CAMINO DOS RIOS  
P. O. BOX 1085  
THOUSAND OAKS, CA 91358-0085

EXAMINER

VAN, LUAN V

ART UNIT	PAPER NUMBER
----------	--------------

1753

DATE MAILED: 09/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No.	Applicant(s)	
	10/672,416	TENCH ET AL.	
	Examiner	Art Unit	
	Luan V. Van	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-33 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-33 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
     Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
     Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |  |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)            |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date ____ | 6) <input type="checkbox"/> Other: ____  |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-5, 8, 10-13, 16, and 18-20 are rejected under 35 U.S.C. 102(b) as being anticipated by Wells et al.

Regarding claims 1-3, 5, 8, 10, and 12, Wells et al. teach a copper electroplating bath, comprising: water as a solvent (column 2 lines 30-41); copper ions (column 1 lines 13-23); pyrophosphate anions (column 2 lines 3-7); Na and K cations added to the electroplating bath as a salt of anions, such that pyrophosphate anions are present in the electroplating bath in stoichiometric excess relative to copper ions (column 2 lines 1-7); and 2,5-dimercapto-1,3,4-thiadiazole organic additive (column 1 lines 54-60).

Regarding claims 4 and 11, Wells et al. teach a copper electroplating bath wherein cations other than copper ions are not electroactive at the potential used for copper electrodeposition, such that relatively pure copper metal is deposited, because it is the same copper electroplating bath.

Art Unit: 1753

Regarding claim 16, Wells et al. teach a copper electroplating bath wherein the 2,5-dimercapto-1,3,4-thiadiazole organic additive (column 1 lines 54-60) has a concentration in the range from 0.5 ppm to saturation (or 3.25 uM to saturation), which is within the range of the instant claim.

Regarding claim 18, Wells et al. teach a copper electroplating bath wherein the pH is maintained in the 7.5 to 9.5 range, which is within the range of the instant claim.

Regarding claim 19, Wells et al. teach a copper electroplating bath comprising ammonia (column 2 lines 15-19).

Regarding claim 20, Wells et al. teach a copper electroplating bath comprising nitrate ion (column 2 lines 15-29).

Claims 1-6, 8-13, 16-19, 21-24, 26-28 and 30-32 are rejected under 35 U.S.C. 102(b) as being anticipated by Merricks et al.

Regarding claims 1-3, 5-6, 8-10, 12-13, and 21-24, Merricks et al. teach a copper electroplating bath, comprising: water as a solvent (paragraph 21); copper ions (paragraph 21); pyrophosphate anions (paragraph 24); Na and K cations added to the electroplating bath as a salt of anions, such that pyrophosphate anions are present in the electroplating bath in stoichiometric excess relative to copper ions (paragraph 24);

Art Unit: 1753

2,5-dimercapto-1,3,4-thiadiazole organic additive (paragraph 28) at a concentration in the range from 0.1 ppm to 1000 ppm (or 0.75  $\mu\text{M}$  to 7500  $\mu\text{M}$ ), which is within the range of the instant claim; and a surfactant (paragraph 29). With respect to claims 9, 21-22, and 24, electrodepositing copper metal in Damascene trenches and vias to form circuitry on semiconductor chips is an intended use of the instant invention and, thus, is not given patentability weight.

Regarding claims 4 and 11, Merricks et al. teach a copper electroplating bath wherein cations other than copper ions are not electroactive at the potential used for copper electrodeposition, such that relatively pure copper metal is deposited (paragraph 10).

Regarding claim 17, Merricks et al. teach a copper electroplating bath wherein the temperature is maintained between 100F to 135F (or 38C to 57C), which is within the range of the instant claim (paragraph 31).

Regarding claim 18, Merricks et al. teach a copper electroplating bath wherein the pH is maintained in the 8.0 to 8.8 range (paragraph 24).

Regarding claim 19, Merricks et al. teach a copper electroplating bath comprising ammonium ion (paragraph 25).

Art Unit: 1753

Regarding claims 26-27, Merricks et al. teach a process for electrodepositing copper circuitry in trenches and vias on semiconductor chips, comprising the steps of: providing a semiconductor chip with trenches and vias to be filled with copper (paragraph 18 and 32); placing said chip in contact with an electroplating bath (example 1), a copper electroplating bath, comprising: water as a solvent (paragraph 21); copper ions (paragraph 21); pyrophosphate anions (paragraph 24); Na and K cations added to the electroplating bath as a salt of anions, such that pyrophosphate anions are present in the electroplating bath in stoichiometric excess relative to copper ions (paragraph 24); and 2,5-dimercapto-1,3,4-thiadiazole organic additive (paragraph 28) at a concentration in the range from 0.1 ppm to 1000 ppm (or 0.75 uM to 7500 uM), which is within the range of the instant claim, and electrodepositing copper in said trenches and vias (example 1).

Regarding claim 28, Merricks et al. teach a copper electroplating process comprising a surfactant (paragraph 29).

Regarding claim 30, Merricks et al. teach a copper electroplating process wherein the temperature is maintained between 100F to 135F (or 38C to 57C), which is within the range of the instant claim (paragraph 31).

Regarding claim 31, Merricks et al. teach a copper electroplating process wherein the pH is maintained in the 8.0 to 8.8 range (paragraph 24).

Regarding claim 32, Merricks et al. teach a copper electroplating process comprising ammonium ion (paragraph 25).

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 7 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Merricks et al. in view of Shipley et al.

Merricks et al. teach the method as described above in addressing claims 1-6, 8-13, 16-19, 21-24, 26-28 and 30-32. Although Merricks et al. teach depositing a copper

Art Unit: 1753

alloy (paragraph 20), the reference does not explicitly teach a copper electroplating bath comprising: ions of at least one electroactive metal selected from the group consisting of silver, zinc, cadmium, iron, cobalt, nickel, tin, lead, bismuth, antimony, gallium and indium

Shipley et al. teach "the copper plate deposited from the preferred solution is alloyed with the Group VIII metal cation and is distinguishable from prior art electroless copper deposits by substantially improved bending or tensile properties and a smoother, more highly reflecting surface appearance" (abstract).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the bath of Merricks et al. by using the Group VIII metal (such as Fe and Co) as taught by Shipley et al., because it would improve the bending or tensile properties of the plated copper.

Claims 14 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Merricks et al. in view of Jonker et al.

Merricks et al. teach the method as described above in addressing claims 1-6, 8-13, 16-19, 21-24, 26-28 and 30-32. The difference between the reference to Wells et al. and the instant claims is that the reference does not explicitly teach using polyoxyethylene(10)isooctylphenylether as a surfactant.



Jonker et al. teach using polyoxyethylene(10)isooctylphenylether (table 3) as a surfactant for plating copper in order to enhance the ductility of the plated copper (column 4 lines 33-44).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to replace the surfactant of Merricks et al. by using the polyoxyethylene(10)isooctylphenylether surfactant of Jonker et al., because the surfactant would enhance the ductility of the plated copper.

Claims 20 and 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Merricks et al. in view of Wells et al.

Merricks et al. teach the method as described above in addressing claims 1-6, 8-13, 16-19, 21-24, 26-28 and 30-32. The difference between the reference to Wells et al. and the instant claims is that the reference does not explicitly teach using nitrate ion.

Wells et al. teach that "the useful range of current density may be further extended by addition of nitric acid, nitrite ions or nitrate ions" (column 2 lines 25-30).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the solution and method of Merricks et al. by using the

Art Unit: 1753

nitrate ions of Wells et al., because it would extend the useful range of current density for plating copper.

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Merricks et al. in view of Wells et al. and Jonker et al.

Merricks et al. teach the method as described above in addressing claims 1-6, 8-13, 16-19, 21-24, 26-28 and 30-32. The difference between the reference to Wells et al. and the instant claims is that the reference does not explicitly teach using nitrate ions nor using polyoxyethylene(10)isooctylphenylether as a surfactant.

Wells et al. teach that "the useful range of current density may be further extended by addition of nitric acid, nitrite ions or nitrate ions" (column 2 lines 25-30).

Jonker et al. teach using polyoxyethylene(10)isooctylphenylether (table 3) as a surfactant for plating copper in order to enhance the ductility of the plated copper (column 4 lines 33-44).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the bath of Merricks et al. by using the nitrate ions of Wells et al., because it would extend the useful range of current density for plating copper, and further replace the surfactant of Merricks et al. by using the

Art Unit: 1753

polyoxyethylene(10)isooctylphenylether surfactant of Jonker et al. in order to enhance the ductility of the plated copper.

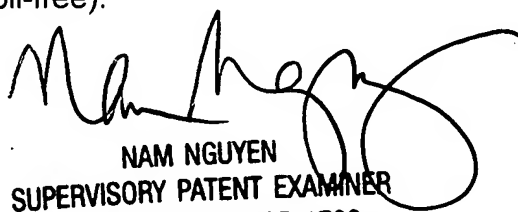
### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luan V. Van whose telephone number is 571-272-8521. The examiner can normally be reached on M-F 8:30-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LVV  
9/8/05

  
NAM NGUYEN  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 1700